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DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371

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U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5)

10/069260

INTERNATIONAL APPLICATION NO.

PCT/DE00/00912

INTERNATIONAL FILING DATE

March 24, 2000

PRIORITY DATE CLAIMED

August 22, 1999

TITLE OF INVENTION

LIGHT SOURCE AND METHOD FOR PRODUCING A LIGHT SOURCE

APPLICANT(S) FOR DO/EO/US

Jörg Arnold

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to promptly begin national examination procedures (35 U.S.C. 371(f)).
4. ☐ The US has been elected by the expiration of 19 months from the priority date (PCT Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☐ is attached hereto (required only if not communicated by the International Bureau).
  - b. ☒ has been communicated by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a. ☐ are attached hereto (required only if not communicated by the International Bureau).
  - b. ☐ have been communicated by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
  - d. ☐ have not been made and will not be made.
- ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
- ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

## Items 11. To 16. Below concern other document(s) or information included:

11. ☒ An Information Disclosure Statement under 37 C.F.R. 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.  
☐ A SECOND or SUBSEQUENT preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information: 3 sheets of drawings  
12 prior art documents

U.S. APPLICATION NO. (if known) <b>10/069260</b> INTERNATIONAL APPLICATION NO. <b>CT/DE00/00912</b>	ATTORNEY'S DOCKET NUMBER 34691/243032																										
17. <input checked="" type="checkbox"/> The following fees are submitted:	CALCULATIONS	PTO USE ONLY																									
<b>Basic National Fee (37 CFR 1.492(a)(1)-(5)):</b> Neither international preliminary examination fee (37 CFR 1.482) nor International search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO <span style="float: right;"><b>\$1,040.00</b></span>  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO <span style="float: right;"><b>\$ 890.00</b></span>  International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search (37 CFR 1.445(a)(2)) paid to USPTO <span style="float: right;"><b>\$ 740.00</b></span>  International preliminary examination fee (37 CFR 1.482) paid to USPTO But all claims did not satisfy provisions of PCT Article 33(1)-(4) <span style="float: right;"><b>\$ 710.00</b></span>  International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) <span style="float: right;"><b>\$ 100.00</b></span>																											
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Surcharge of <b>\$130.00</b> for furnishing the oath or declaration later than <input type="checkbox"/> 20 <input type="checkbox"/> 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	<b>\$</b>																										
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 20%;">CLAIMS</th> <th style="width: 20%;">NUMBER FILED</th> <th style="width: 20%;">NUMBER EXTRA</th> <th style="width: 20%;">RATE</th> <th style="width: 20%;"></th> </tr> </thead> <tbody> <tr> <td>Total Claims</td> <td>5 - 20 =</td> <td>0</td> <td><b>X \$18.00</b></td> <td><b>\$ 0.00</b></td> </tr> <tr> <td>Independent Claims</td> <td>2 - 3 =</td> <td>0</td> <td><b>X \$84.00</b></td> <td><b>\$ 0.00</b></td> </tr> <tr> <td colspan="3">MULTIPLE DEPENDENT CLAIM(S) (if applicable)</td> <td><b>+ \$280.00</b></td> <td><b>\$</b></td> </tr> <tr> <td colspan="4" style="text-align: right;"><b>TOTAL OF ABOVE CALCULATIONS =</b></td> <td><b>\$ 890.00</b></td> </tr> </tbody> </table>	CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		Total Claims	5 - 20 =	0	<b>X \$18.00</b>	<b>\$ 0.00</b>	Independent Claims	2 - 3 =	0	<b>X \$84.00</b>	<b>\$ 0.00</b>	MULTIPLE DEPENDENT CLAIM(S) (if applicable)			<b>+ \$280.00</b>	<b>\$</b>	<b>TOTAL OF ABOVE CALCULATIONS =</b>				<b>\$ 890.00</b>		
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Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). <b>\$40.00</b> per property +	<b>\$</b>																										
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a. <input checked="" type="checkbox"/> A check in the amount of \$ 890.00 to cover the above fees is enclosed. b. <input type="checkbox"/> Please charge my Deposit Account No. 16-0605 in the amount of \$      to cover the above fees. A duplicate copy of this sheet is enclosed. c. <input checked="" type="checkbox"/> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 16-0605.																											
Note: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137 (a) or (b)) must be filed and granted to restore the application to pending status.																											
SEND ALL CORRESPONDENCE TO: Charles B. Elderkin <i>Charles B. Elderkin</i>																											
SIGNATURE REGISTRATION NUMBER 24,357 <b>ALSTON &amp; BIRD LLP</b> Bank of America Plaza 101 South Tryon Street, Suite 4000 Charlotte, NC 28280-4000 Tel Charlotte Office (704) 444-1000 Fax Charlotte Office (704) 444-1111 <b>Customer Number 00826</b>																											
<b>"Express Mail" Mailing Label Number EL 910299031 US</b> Date of Deposit: February 22, 2002  I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to BOX PCT, Attn: DO/US (PTO) Commissioner for Patents, Washington, DC 20231. <i>Joyce D. Smith</i> Joyce D. Smith																											

10 / 069260

IN THE UNITED STATES DESIGNATED OFFICE (DO/US)

In re: Arnold Attn: DO/US  
International Appl. No.: PCT/DE00/00912  
International Filing Date: March 24, 2000  
For: LIGHT SOURCE AND METHOD FOR PRODUCING A LIGHT SOURCE

February 22, 2002

Box PCT  
Commissioner for Patents  
Washington, DC 20231

PRELIMINARY AMENDMENT

Sir:

Kindly amend the above identified application as follows:

In the Claims

Cancel Claims 4-20 and 23-28, without prejudice.

[illegible]

In re: Arnold  
Inter'l Appl. No.: PCT/DE00/00912  
Page 2 of 2

JC13 Rec'd PCT/PTO 22 FEB 2002

## REMARKS

The present Amendment serves to remove the multiple dependent claims from the application, and it is requested that the Amendment be entered prior to the calculation of the filing fee.

The applicant expressly reserves the right to subsequently submit new claims directed to the subject matter of the presently cancelled claims.

Respectfully submitted,



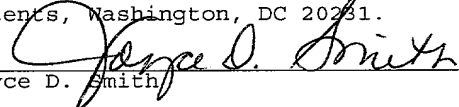
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Joyce D. Smith

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3 / parts

# LIGHT SOURCE AND METHOD FOR PRODUCING A LIGHT SOURCE

The invention relates to a light source, in particular incandescent lamp, with a bulb, a filament arranged in the bulb, and a heating device for the filament, the filament emitting both visible light and heat radiation. Furthermore, the invention relates to a method for producing a light source of the above mentioned type.

Light sources of the described type have been known from practice for a long time, and they exist in a large variety of designs and sizes. In this connection, for example, incandescent lamps are known as electrical light sources, in which it is common to bring a tungsten filament by electrical Joule heat to a highest possible temperature. In this process, a temperature radiation is generated. The light yield of incandescent filaments considerably increases as the temperature rises. Besides that, also so-called nonthermal sources of radiation are known, for example, discharge lamps, such as inert gas-, mercury-, sodium-, and metal halide discharge lamps in high-pressure and low-pressure designs.

All so far known, electrically operated types of light sources have the disadvantage that they are very inefficient with respect to converting electric power to visible light output. The conversion barely exceeds 30%. The largest portion of the consumed electric power is an uneconomical dissipation primarily in the form of heat.

A possibility of increasing the efficiency of known light sources consists in that the heat radiated from the filament or glow wire, is reflected from the inner side of the bulb back to the filament or glow wire. As a result, the filament or glow wire undergoes a kind of backheating. This results in that after reaching the

same filament temperature, less electric power will be needed than during a heating without reflection. The visible light output, which is transmitted through the bulb, remains in this instance the same. In the ideal case, only that electric power will be needed, which corresponds to the visible, emitted light output and to the thermal dissipation, which is absorbed by the bulb. Thus, the conversion efficiency is improved by the portion of the reflected heat radiation. Theoretically, it would be possible to increase with that the conversion efficiency to as much as 75% or 140 lumens/watt, if one took as a basis the standard thermal dissipation of tungsten lamps of about 25%, and if one neglected the radiation absorption of a mirror coating on the inner side of the bulb. In this connection, for example, dielectric mirror coatings have an absorption of typically 0.1%.

In the case of a mirror coating on the inner side of the bulb with a reflection power of, for example, 99.9%, statistically, every one thousandth photon in the material of the mirror coating will be absorbed. In the case of a reflection of the radiation into the bulb, the photon flux may therefore undergo only 1000 reflections on the inner side of the bulb, until it is totally absorbed in the bulb.

The known filaments present a problem in that, for example, the known spiral form of the filaments or glow wires permits only a very slight absorption of the reflected heat radiation, since the largest portion of the heat radiation is reflected past the thin spiral wire. Thus, an effective absorption or backheating is not possible in the case of conventional filaments or glow wires. Consequently, a high conversion efficiency is not realizable with conventional light sources.

It is therefore an object of the present invention to describe a light source of the initially described type as well as a method for producing such a light source, wherein a high conversion efficiency is achieved with simple means.

The foregoing object is accomplished on the one hand by a light source with the characterizing features of claim 1. Accordingly, a light source is designed and constructed such that the filament has a flat section.

In accordance with the invention, it has been recognized that the likelihood of the photon flux striking on its path of reflection the filament or glow wire and being there absorbed, is proportional to the ratio of the filament volume or filament surface to the reflecting bulb volume or reflecting bulb surface. To realize a highest possible backheating of the filament, it will be advantageous, when a large filament surface is present, so that the photon flux strikes the filament after fewest possible reflections on the inner side of the bulb, and that it is there absorbed.

Consequently, the light source of the present invention defines a light source, which permits realizing a high conversion efficiency with simple means.

To optimize the reflection behavior of the inner side of the bulb, which is transparent for visible light, the bulb could include a mirror coating on its inner side. In a particularly favorable manner, the mirror coating could be a dielectric multilayer coating. With that, a spectrally selective mirror coating is present, which largely reflects the portion of heat radiation and transmits the portion of visible radiation.

An enlarged filament surface could result in the disadvantage that the electrical resistance of the filament becomes smaller, since the conductor surface

that is decisive for the electric current becomes larger. From this follows, that for reaching the filament temperature necessary for the light emission, a considerably higher current is required in the filament than in the case of a normal filament surface or normal filament cross section. This may lead to safety problems for the user of the light source. In summary, this case presents a dilemma with respect to a largest possible filament surface and the therefor required and disadvantageous high currents. Furthermore, a large-surface filament could involve the disadvantage that it is mechanically unstable in particular in the case of substantial heating, and that it is deformed as a result of the effect of gravity. In the extreme case, the filament could come into contact with the inner side of the bulb, and/or become inoperative.

To solve the foregoing problematic situation, the filament could be made at least in part from a sintered metal. One could visualize such a sintered metal as a porous sponge, in which the powder elements or grains of the basic material include in most cases only point welding contacts relative to one another. This results in an extremely small, effective, and electrically conductive cross section and an increased effective conductor length. Furthermore, the sintered material exhibits a high mechanical stability. Therefore, an increased electrical resistance on the one hand and an increased mechanical strength on the other hand are made available by the use of the sintered metal powder. This favors the use of large-surface filaments.

The filament or the metal powder could include tungsten, and/or tantalum, and/or rhenium, and/or niobium, and/or zirconium. In practice, tantalum has shown to be especially favorable. In the alternative or



in addition thereto, the filament could be composed at least in part of a nonmetal. Likewise, this makes it possible to achieve an increase in the electrical resistance.

5 For further increasing the mechanical stability of the filament in general or of a filament of a sintered metal powder, the filament could be composed at least in part of tantalum carbide, and/or rhenium carbide, and/or niobium carbide, and/or zirconium carbide. Concretely, 10 one or more of the last-mentioned carbides could be used as a coating material for a filament of sintered metal powder. Quite generally, the filament could be coated with a coating material, which has a higher melt point than the filament material. A coating of the filaments 15 as described above would make it possible to achieve during operation surface temperatures, which are higher than is usual for known tungsten filament lamps.

Concretely, the filament could be composed of a base body of sintered tantalum, which has an outer layer of 20 tantalum carbide. Tantalum carbide is an extremely temperature-resistant hard material, which produces in the porous, spongy topology of the sintered material, because of crosslinking, a high mechanical or static strength of the material in the fashion of a framework. 25 Therefore, as expected, the filament material has an extremely high ohmic resistance and an adequate strength to avoid flowability of the hot filament during operation

In an especially favorable manner in terms of construction, the flat section could be designed and 30 constructed as a strip with two longitudinal sides. Furthermore, on the two longitudinal sides, respectively two surface elements could project from the strip in the fashion of wings. All four surface elements would extend from the strip, each at an angle of about 90°. In other

words, the flat section could be present in the form of two channel sections, the two channel sections being coupled with each other at respectively one end and adjoining each other almost back to back. At the  
5 opposite end of the channel sections, the electrical bonding for the filament is provided. With such a flat section, the filament has a very favorable absorption behavior for heat radiation.

As an alternative to the foregoing configuration, it  
10 would be possible to make the flat section the form of a cup or cylinder jacket. In this connection, it is possible to have a configuration as a complete cylinder jacket or even a part thereof, in particular a cylinder jacket half. In the case of a substantially complete  
15 cylinder jacket, it would also be possible to make such a cylinder jacket on its side open or longitudinally slotted. This is favorable with respect to the thermal expansion behavior of the filament.

To ensure a particularly effective absorption of the  
20 heat radiation reflected from the inner side of the bulb, the diameter of the cylinder jacket, or cylinder jacket portion, or cylinder jacket half could be only slightly smaller than the diameter of the bulb. In this connection, the bulb could be tubular. In particular in  
25 this instance, it would be possible to arrange the filament in the bulb in concentric relationship and/or coaxial relationship with a longitudinal axis of the bulb.

Depending on its configuration, the filament could  
30 divide the interior of the bulb into one or more half spaces or subspaces.

The bulb could have such a large outer surface that surface heat, which is generated by, for example, absorption of the heat radiation, can be dissipated by

convection cooling or any other forced cooling. The size and form of the filament and the bulb could be adapted to each other accordingly.

As a result of the large possible surface of the filament, it is possible to build light sources with high light outputs. It is likewise possible to adjust the color temperature of the light source independently of the surface temperature of the filament or incandescent element. This may occur by a spectrally selective mirror coating, which is capable of predetermining the transmitted spectral distribution of the radiation output emitted from the bulb and thus the color temperature.

In comparison with conventional filaments, the surface temperature of the filament may be adjusted lower, since the comparable visible light current can be generated by a larger and cooler surface of the filament. In this connection, the filament surface forms a new, additional degree of freedom in terms of construction.

While it is possible to operate the filament at a relatively low temperature, and while this also allows to achieve a relatively low evaporation of the filament material, a disturbing evaporation may occur because of the very large surface, which is as close as possible to the inner side of the bulb with respect to an effective absorption. As a result of the filament material, which has evaporated and settled on the inner side of the bulb, the reflectivity of the inner side of the bulb or of the mirror coating on the inner side of the bulb is reduced, and the absorption of the bulb or mirror coating and thermal dissipation respectively are increased. It is therefore desirable to minimize the evaporation of the filament material to the greatest extent possible.

For minimizing the evaporation of the filament material, the bulb could contain an inert gas and/or a

halogen gas. In this instance, the halogen gas could contain bromine and/or iodine. With that, it would be possible to generate a normal tungsten iodide circulation in the case of a tungsten filament.

5 An alternative solution to the evaporation problems could occur by coating the filament with a coating material, which has a higher melt point than the filament material. This lies in the dependency of the temperature-dependent vapor pressure of a solid from its  
10 melt point. Furthermore, the deposit of the coating material could exhibit a lesser absorptivity than the deposit of the standard filament material. As a coating material with a very high melt point, it would be possible to use, for example, tantalum carbide, and/or  
15 rhenium carbide, and/or niobium carbide, and/or zirconium carbide.

As a result of the constructionally necessitated large filament surface, it is possible to generate very high light currents and to emit them from the light  
20 source, so as to enable an illumination of large building interiors or outdoor areas with only one light source according to the invention.

The above-described object is furthermore accomplished by a method for producing a light source of  
25 the initially described type with the characterizing steps of claim 21. Accordingly, a filament of a sintered metal powder is provided in a first step. By sintering the metal powder, it is possible to control the conductivity of the sintered material by means of the  
30 initial grain size and the compacting of the powder as well as the sintering temperature. As a result, it is possible to produce a material of a correspondingly high ohmic resistance and mechanical stability. This enables the use of filaments with large, flat sections, without

the conductor cross section, which is important for the electrical resistance, leading to a low resistance, and without mechanical instabilities occurring because of the large surface area and under the influence of gravity.

5 Even at high operating temperatures, a sagging or flowing of the filament material does not occur.

Use is made of the porous, spongy topology of the sintered filament for generating a high mechanical stability of the material, in that the filament is  
10 exposed to an atmosphere of carbon dioxide or of carbon dioxide and inert gas for forming a metal carbide. In other words, by exposing the filament to a corresponding gas atmosphere, a metal carbide coating is produced on the outer side of the filament. Depending on the coating  
15 thickness or depth of penetration of the metal carbide reaction, the effective electrical resistance is further reduced. At process temperatures higher than 1000°C, the carbide starts to form, and at process temperatures higher than 1400°C, the complete carburation occurs after  
20 a certain duration of the process.

The metal carbide is an extremely temperature-resistant hard material, which produces respectively a mechanical and a static strength of the filament because of a crosslinking in the porous, spongy topology of the  
25 filament material. Therefore, as expected, the filament material has an extremely high ohmic resistance and is adequately resistant for preventing a flow behavior of the hot filament during operation.

Once the formation of the metal carbide coating has  
30 generated an adequate strength, it is possible to increase the process temperature and, later, also the operating temperature of the metal carbide-metal filament above the melt point of the metal. The metal carbide forms a solid coating around the liquid metal core.

Possible tension breaks in the metal carbide coating, for example, because of different thermal heat expansion coefficients, are repaired by the liquid metal exiting at the breaks, or by the then immediately starting formation of the metal carbide.

At the end of the production method, the filament is sealed into the bulb, and a light source having a high conversion efficiency is made available.

By rolling the filament to a foil after its preparation, it is possible to carry out an additional compacting step in the method, whereby conductivity is likewise influenced.

As regards a particularly reliable production of the filament, it would be possible to insert the filament after making it available, into a bulb that is open at two ends, and to bond it electrically at one end of the bulb. Thus, after having been provided and rolled, if necessary, the filament would be already available in the bulb in a protected manner. This provides a mechanical protection during further steps of the method.

After inserting the filament into the bulb, it would be possible to close the one end. In this process, one could arrange on the filaments, standard electrical connections, if need, of tungsten wire and/or molybdenum strips, and fuse or press them together with the end. The bulb could be formed by a quartz tube.

In a particularly simple manner, it would now be possible to expose the filament to an atmosphere of carbon dioxide or of carbon dioxide and inert gas by the inflow of a carbon dioxide gas or a gas of carbon dioxide and inert gas through the other end of the bulb. Furthermore, it would be possible to heat the filament electrically before and/or during the formation of a metal carbide. This would permit controlling the

formation of metal carbide, if need be, until its completion. In particular, it would be possible to control the formation of metal carbide with the aid of the resistance characteristic of the filament. To this end, the heating current and heating voltage could be measured via the electrical bonding of the filament, and be accordingly used for the control. In other words, the formation of metal carbide could be directly monitored and, consequently, controlled via the electrical voltage-current characteristic or via the electrical resistance characteristic.

Other production methods, wherein the filaments of metal carbide and metal are not heated directly electrically and produced outside of the bulb, have the disadvantage that it is not possible to adjust directly the formation of the metal carbide or the electrical resistance of the filaments, which is to be attained, and that the filaments of metal carbide and metal may be very fragile outside of the bulbs.

As a metal powder, it would be possible to use tungsten, and/or rhenium, and/or niobium, and/or zirconium, and/or in particular tantalum. With the use of tantalum, it would be possible to make use of the extremely good deformability of tantalum. Since tantalum carbide has a very high melt temperature, one can expect at the normal operating temperatures of light sources, an extremely low evaporation speed of the tantalum carbide, and very little fogging of the bulb. Furthermore, tantalum carbide is black in the visible spectrum and, therefore, a high spectral emissivity of the tantalum carbide is present. In particular, in comparison with nonporous surfaces, the porous tantalum carbide surface shows an increased blackness in the meaning of the Planck blackbody radiation.

The further advantage of a filament of tantalum carbide and tantalum lies in its thermal conductivity, which is only about half as much in comparison with tungsten filaments. Together with the large reabsorbing surface of the filament of tantalum carbide and tantalum and the infrared radiation respectively, which is less often reflected on the inner sides of the bulb, and therefore less absorbed, and the comparably little thermal conductivity, a substantially lesser thermal dissipation is achieved. It would be possible to heat the filament of tantalum carbide and tantalum to the maximally possible operating temperature of tungsten filaments.

There exist various possibilities of improving and further developing the teaching of the present invention in an advantageous manner. To this end, one may refer on the one hand to the claims dependent from both claim 1 and claim 21, on the other hand to the following detailed description of a preferred embodiment of a light source with reference to the drawing. In conjunction with the detailed description of preferred embodiment of a light source with reference to the drawing, also generally preferred improvements and further developments of the teaching are described. In the drawing:

Figure 1 is a perspective side view of the embodiment of a light source according to the invention;

Figure 2 is a perspective side view of the embodiment of Figure 1, 90° out of phase relative to the view of Figure 1; and

Figure 3 is a top view of the embodiment of Figure 1.

Figure 1 is a perspective side view of an embodiment of a light source according to the invention. The light source is designed and constructed as an incandescent



lamp, which comprises a bulb 1 that accommodates a filament 2 or incandescent element. For heating the filament 2, a heating device 3 is provided, which makes available an electric current. The heated filament 2 emits both visible light and heat radiation.

With respect to a high conversion efficiency of the light source, the filament 2 comprises a flat section 4. The flat section 4 enables a high degree of absorption of the heat radiation reflected from the inner side of bulb 1 and originally radiated from filament 2, whereby the filament 2 is quasi backheated. Therefore, for achieving the same light output of the light source, it is possible to supply to the light source less energy than is the case with conventional light sources. Consequently, it is possible to operate the light of the present invention with less energy and thus more economically than conventional light sources.

Arranged on the filament 2 are power supply conductors 5, which are coupled with electrical contacts 6 of the heating device 3. The inner side of bulb 1 is provided with a mirror coating 7, which substantially increases the reflection power of the inner side of bulb 1 for the heat radiation.

The filament 2 is composed of essentially two channel sections 8. The channel sections 8 are electrically coupled at their upper ends. At their lower ends, the channel sections 8 are each bonded to a current supply conductor 5. In other words, the flat section 4 of filament 2 is constructed as a strip with two longitudinal sides 9, from which respectively two surface elements 10 project from the strip in the fashion of wings. A total of four surface elements 10 project from the strip, each at an angle of about 90°.

The entire electrical bonding of the light source is provided at an lower end 11 of bulb 1.

The filament 2 consists of a sintered tantalum powder and a coating of tantalum carbide on its surface.

5 Figure 2 illustrates the light source of Figure 1 in a position rotated by 90 degrees about the longitudinal axis of bulb 1. In this position, the surface elements 10 are best seen. The channel section 8 is formed respectively by two surface elements 10 and one strip or  
10 strip-shaped base portion of the filament 2. As regards the description of further elements of the light source, the description of Figure 1 is herewith incorporated by reference.

15 Figure 3 illustrates the embodiment of a light source of Figure 1 in a plan view. Best seen in this illustration are the two channel sections 8, which are interconnected at their upper ends. The filament 2 is arranged in bulb 1 in coaxial relationship therewith. The power supply conductors 5 are arranged on the inner  
20 sides of the channel sections 8. A mirror coating 7 is applied to the inner side of bulb 1. The surface elements 10 extend along the longitudinal sides 9 of the filament.

25 As regards further advantageous improvements and further developments of the teaching according to the invention, the general part of the description on the one hand and the attached claims on the other are herewith incorporated by reference.

30 Finally, it should be expressly emphasized that the foregoing, merely arbitrarily selected embodiment is used only for explaining the teaching of the present invention, without however limiting same to this embodiment.

## C L A I M S

1. Light source, in particular incandescent lamp,  
with a bulb (1), a filament (2) arranged in the bulb (1),  
5 and a heating device (3) for the filament (2), the  
filament (2) emitting both visible light and heat  
radiation,  
**characterized in** that the filament (2) includes a flat  
section (4).

2. Light source of claim 1, characterized in that  
the bulb (1) includes on its inner side a mirror coating  
(7).

3. Light source of claim 2, characterized in that  
the mirror coating (7) is formed by a dielectric  
multilayer coating.

4. Light source of one of claims 1-3,  
20 characterized in that the filament (2) is composed at  
least in part of a sintered metal powder.

5. Light source of one of claims 1-4,  
characterized in that the filament (2) or the metal  
25 powder contains tungsten and/or tantalum and/or rhenium  
and/or niobium and/or zirconium.

6. Light source of one of claims 1-5,  
characterized in that the filament (2) is composed at  
30 least in part of a nonmetal.

7. Light source of one of claims 1-6,  
characterized in that the filament (2) is composed at

least in part of tantalum carbide and/or rhenium carbide and/or niobium carbide and/or zirconium carbide.

8. Light source of one of claims 1-7,  
5 characterized in that the filament (2) is coated with a coating material, which has a higher melt point than the filament material.

9. Light source of claim 8, characterized in that  
10 the coating material contains tantalum carbide and/or rhenium carbide and/or niobium carbide and/or zirconium carbide.

10. Light source of one of claims 1-9,  
15 characterized in that the flat section (4) is constructed as a strip with two longitudinal sides (9).

11. Light source of claim 10, characterized in that  
20 on the two longitudinal sides (9), two surface elements (10) each project from the strip in the fashion of wings.

12. Light source of claim 11, characterized in that  
the four surface elements (10) project from the strip each at an angle of about 90 degrees.

13. Light source of one of claims 1-9,  
characterized in that the flat section is designed and constructed in the shape of a cup or cylinder jacket.

14. Light source of one of claims 1-9,  
30 characterized in that the flat section is designed and constructed as a cylinder jacket half.

15. Light source of one of claims 1-9,  
characterized in that the flat section is designed and  
constructed as an open, longitudinally slotted cylinder  
jacket.

5

16. Light source of one of claims 13-15,  
characterized in that the diameter of the cylinder jacket  
or cylinder jacket half is only slightly smaller than the  
diameter of the bulb.

10

17. Light source of one of claims 1-16,  
characterized in that the filament (2) is arranged in the  
bulb (1) in concentric relationship.

15

18. Light source of one of claims 1-17,  
characterized in that the filament (2) is arranged in  
coaxial relationship with a longitudinal axis of the bulb  
(1).

20

19. Light source of one of claims 1-18,  
characterized in that the bulb contains an inert gas  
and/or a halogen gas.

25

20. Light source of claim 19, characterized in that  
the halogen gas contains bromine and/or iodine.

30

21. Method for producing a light source, in  
particular a light source of one of the foregoing claims,  
and in particular an incandescent lamp, with a bulb (1),  
a filament (2) arranged in the bulb (1), and a heating  
device (3) for the filament (2), the filament (2)  
emitting both visible light and heat radiation,  
**characterized by** the following steps:

providing a filament (2) of a sintered metal powder;

exposing the filament (2) to an atmosphere of carbon dioxide or of carbon dioxide and inert gas for forming a metal carbide; and

sealing the filament (2) into the bulb (1).

5

22. Method for producing a light source according to claim 21, characterized in that after having been made available, the filament (2) is rolled to a foil.

10

23. Method for producing a light source according to claim 21 or 22, characterized in that after having been made available, the filament (2) is inserted into the bulb (1), which is open at its two ends, and that it is electrically bonded at one end (11) of the bulb (1).

15

24. Method for producing a light source according to claim 23, characterized in that the one end (11) is closed.

20

25. Method for producing a light source according to claim 23 or 24, characterized in that the step of exposing the filament (2) to an atmosphere of carbon dioxide or of carbon dioxide and inert gas occurs by the inflow into the bulb (1) of a carbon dioxide gas or a gas of carbon dioxide and inert gas through the other end of the bulb (1).

25

26. Method for producing a light source according to one of claims 21-25, characterized in that the filament (2) is electrically heated before and/or during the formation of metal carbide.

30

27. Method for producing a light source according to one of claims 21-26, characterized in that the

formation of metal carbide is controlled with the aid of the resistance characteristic of the filament (2).

- 5        28. Method for producing a light source according to one of claims 21-27, characterized in that the metal powder contains tungsten and/or tantalum and/or rhenium and/or niobium and/or zirconium.

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**ABSTRACT**

A light source, in particular incandescent lamp,  
with a bulb (1), a filament (2) arranged in the bulb (1),  
5 and a heating device (3) for the filament (2), the  
filament (2) emitting both visible light and heat  
radiation, is designed and constructed with respect to a  
high conversion efficiency between an electrical power  
input and emitted light output such that the filament (2)  
10 includes a flat section (4). A light source of this type  
may be produced by a method, wherein initially a filament  
(2) of a sintered metal powder is provided.  
Subsequently, the filament (2) is exposed to an  
atmosphere of carbon dioxide or of carbon dioxide and  
15 inert gas for forming a metal carbide. Finally, the  
filament (2) is sealed into the bulb (1).

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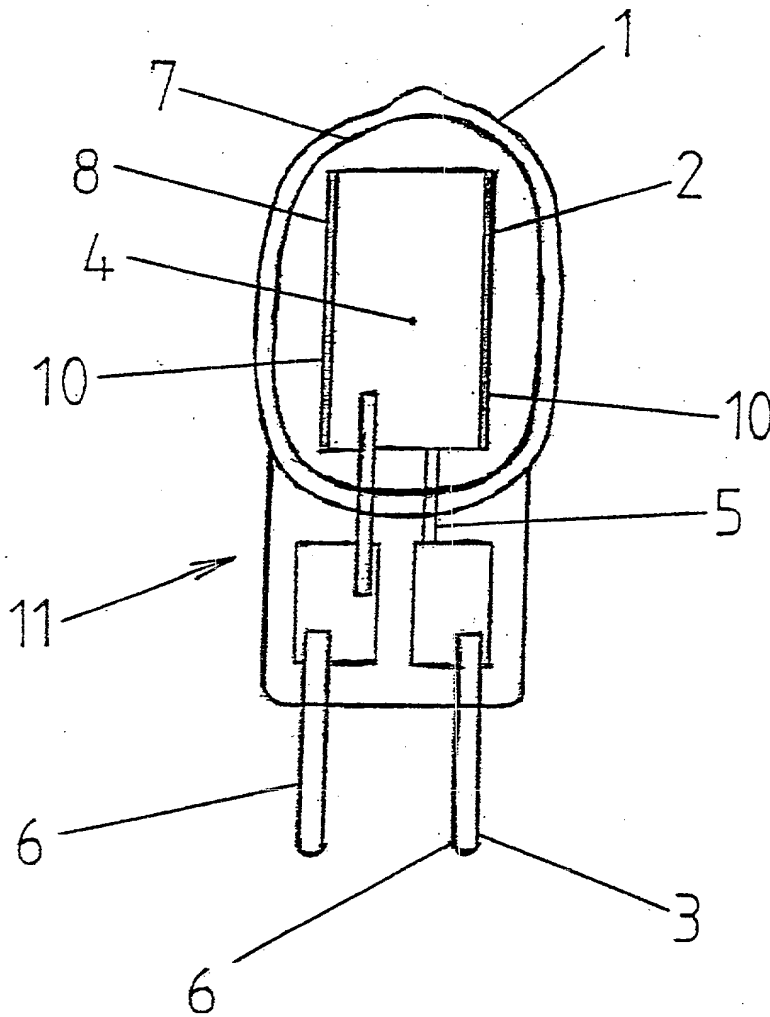


Fig. 1

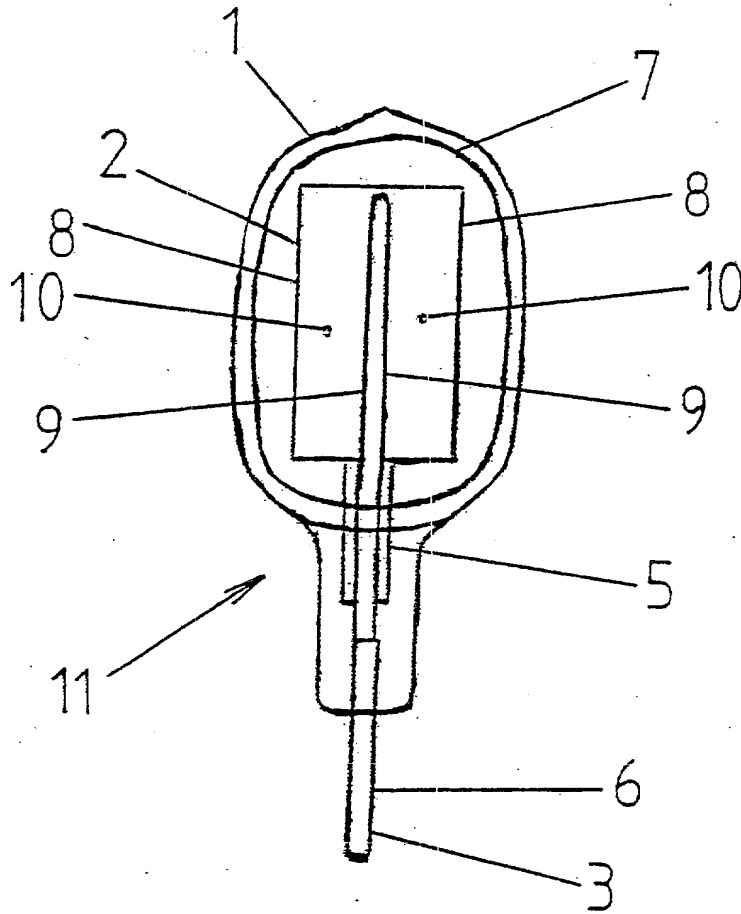


Fig. 2

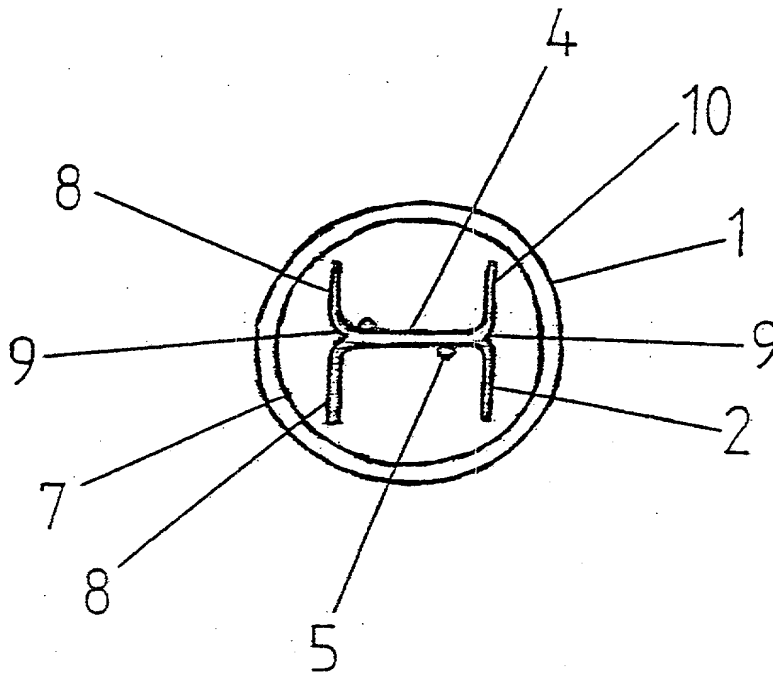


Fig. 3

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As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**LIGHT SOURCE AND METHOD FOR PRODUCING A LIGHT SOURCE**

the specification of which is attached hereto unless the following box is checked:

☒ was filed on 24 March 2000 as United States Application Number or PCT International Application Number PCT/DE00/00912 and was amended on \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

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Priority Not Claimed  
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22 August 1999 ☐  
(Day/Month/Year Filed)  
(Tag/Monat/Jahr der Anmeldung)

08 October 1999 ☐  
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**POWER OF ATTORNEY:** As a named inventor, I hereby appoint the following attorney(s) to prosecute this application and transact all business in the Patent and Trademark office connected therewith: (list name and registration number)

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Unterschrift des Erfinders	Datum	Inventor's signature	Date
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